CHROMOSOME COUNTS IN THE SECTION SIMIOLUS OF THE GENUS MIMULUS (SCROPHULARIACEAE). II.

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This cytological study[1], which is a continuation of a previous investigation of chromosome numbers in section *Simiolus* (Vickery, 1955), forms an integral part of a long range experimental study of the taxonomy, cytogenetics, and evolution of species in the genus *Mimulus* (Vickery, 1951). The counts were determined from observation of various stages of microsporogenesis. Many different techniques of fixation and staining were tried in an attempt to develop a better method than the one previously used (Vickery, 1955).

An effective and comparatively simple method was developed for obtaining chromosome counts. Buds of proper size, which varied from 1.6 to 3.1 millimeters, were killed and fixed for about two hours in a mixture of one part acetic acid to two parts distilled water. Buds that could not be studied immediately were stored in 70% ethanol. The best time for fixation proved to be from 9 to 11 a. m. The anthers were dissected out of the buds and stained in strong aceto-carmine. The stain was prepared by dissolving 1 gram of carmine in 100 mls. of boiling 45% acetic acid. It was cooled and filtered before use. The anthers were placed in a drop of stain on a microscope slide and heated gently over an alcohol flame. A cover slip was added and pressed firmly with a match stick to squash the anthers. From time to time during the next half hour more stain was added, more pressure applied and more heat used. The excess stain was removed with a paper towel pad. The coverglass was sealed with a half and half mixture of beeswax and paraffin. In a few cases propionic acid was substituted, with equally satisfactory results, for acetic acid in the above schedule.

The slides were examined within a day or two and the best figures found were drawn with the aid of a camera lucida (fig. 1). The method of Bhaduri and Ghosh (1954) was employed to make the slides permanent but with only moderate success. Herbarium specimens of all the cultures counted have been prepared for future reference and will be deposited in the Garrett Herbarium of the University of Utah under the culture numbers given in Table 1.

The chromosome numbers were found to be n=16 for *M. dentilobus* Rob. & Fern. from Chihuahua, Mexico, n=15 for *M. glabratus* var. *utahensis* Pennell from southern Utah, and n=14 for the ten cultures of *M. guttatus* DC. from California and northern Utah. These taxa appear to form an aneuploid sequence and a geographic series linking a group of North American taxa reported as n=14 (Campbell, 1950, and Vickery,

[1] The work was supported by grants from the National Science Foundation and the University of Utah Research Fund. The authors wish to thank Drs. W. W. Newby and C. M. Woolf for their helpful criticisms of the manuscript.

Table 1. Chromosome Counts in Mimulus, Section Simiolus

n = 16	*M. dentilobus* Rob. & Fern.	Sierra Charro, Chihuahua, Mexico. *Gentry 8073* (5324).
n = 15	*M. glabratus* var. *utahensis* Pennell.	Fremont River, Bicknell, Wayne County, Utah, altitude 7100 feet, *Vickery 600* (5265).
n = 14	*M. guttatus* DC.	Mono Inn, Mono County, California, altitude 6420 feet, *Clausen 2043* (5015).
		Darwin Falls, Inyo County, California, altitude 2500 feet, U. C. Herbarium 696020 (5017).
		Mt. Diablo, Contra Costa County, California, altitude 1000 feet, *Stebbins 703* (5052).
		Mt. Oso, Stanislaus County, California, altitude 1000 feet, *Vickery 190* (5346).
		Bountiful, Salt Lake County, Utah, altitude 4800 feet, *Vickery 331* (5835).
		Mill Creek Canyon, Salt Lake County, Utah, altitude 5800 feet, *Vickery 335* (5840).
		Alta, Salt Lake County, Utah, altitude 8800 feet, *Vickery 336* (5845).
		Kimball Junction, Summit County, Utah, altitude 6600 feet, *Vickery 341* (5856).
		Hailstone, Wasatch County, Utah, altitude 6300 feet, *Vickery 342* (5857).
		Rock Creek, below Davies Resort, Duchesne County, Utah, altitude 7600 feet, *Del Wiens* 8/5/56 (5968).

1955) with a group of South American taxa reported as 2n=32, 48, and ca. 64 by Sugiura, Maude, and Brozek, respectively (Darlington and Wylie, 1955). However, the distinctive morphological characteristics of *M. dentilobus* (Grant, 1924) suggest to the authors that it is not a link in this aneuploid series and is not closely related to any of the North or South American species of *Mimulus*. Furthermore, interspecific crosses (Vickery, 1956) indicate that *M. dentilobus* is genetically isolated from all the other taxa of its section. Therefore, it appears to be an evolutionary sideshoot from the main group of *Simiolus* species. On the other hand, the morphology of *M. glabratus* HBK., which is the only species of the section common to North and South America, indicates relationships to both the North and South American groups of species. An n=14 culture of *M. glabratus* var. *utahensis* (5048) hybridizes with members of the various taxa of the two groups although the hybrids are nearly sterile (Vickery, 1956). Therefore, in view of the possible evolutionary role of *M. glabratus* as a connecting link between the North and South American taxa

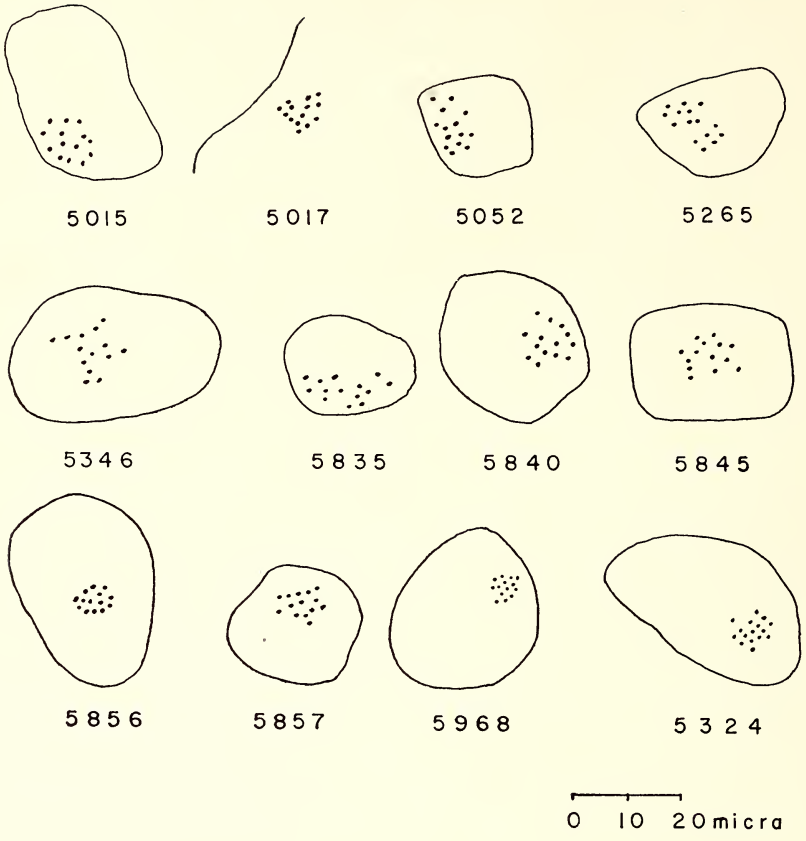

FIG. 1. Meiotic chromosomes of pollen mother cells of *Mimulus*, × 750. All drawings were made with the aid of a camera lucida. The numbers below the figures are the culture numbers (Table 1). The ten cultures of *M. guttatus* are n=14. The one culture of *M. glabratus* var. *utahensis* (5265) is n=15. *M. dentilobus* (5324) is n=16. All plants are in first metaphase except 5015, 5968, and 5324 which are in second metaphase.

of section *Simiolus*, the aneuploid number of n=15 for the Bicknell culture (5265) of *M. glabratus* var. *utahensis* is particularly interesting and significant. Further work is in progress to be sure that this count does not represent merely an aberrant individual.

The extensive hybridization experiments mentioned above (Vickery, 1956) reveal crossing barriers of various degrees between the different cultures of *M. guttatus*. However, in no case is a culture completely isolated from all the others. The results of these crosses suggested to the authors that all the cultures of the races of *M. guttatus* would have the

same chromosome number. Our cytological observations confirm this idea and suggest, further, that the crossing barriers are due not only to gene differences but also to differences in chromosome structure. For example, culture 5968 has markedly smaller chromosomes than the other cultures. Probably there are cryptic structural differences in the chromosomes of the cultures as well.

In conclusion, we may report that our studies indicate that the North American *M. guttatus* complex of species (n=14) appears to be related to the South American *M. luteus* complex (x=8) by a series of aneuploid forms of *M. glabratus*. Work is in progress to determine the chromosome numbers of additional taxa and to determine the chromosomal homologies of the various cultures and races in order to clarify further our understanding of the evolutionary relationships in the group.

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ON THE SPECIFIC DISTINCTNESS OF RUDBECKIA LACINIATA AND R. AMPLA

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Wild goldenglow, *Rudbeckia laciniata* L. (Sp. Pl. 906, 1753), is a rather familiar plant growing in alluvial soil in eastern United States and adjacent Canada, ranging from Quebec to Manitoba and southward to eastern Texas and Florida. A morphologically similar plant described from Colorado in 1901 as *R. ampla* A. Nels., occurring in the western parts of the continent from Saskatchewan to South Dakota, New Mexico, Arizona, and Idaho, is less well known, and generally has been treated by contemporary students of the western flora as a synonym of *R. laciniata*.

There is evidence, however, on the basis of study of morphological characters, habitat, and habit, as well as geographical distribution, that